## 2. Overview Chart

### Bioinspired Broadband Antireflection Coatings at Long Wavelengths for Space Applications

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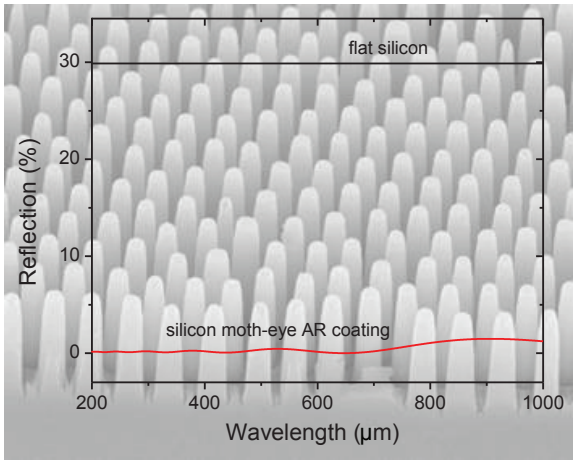
### Research Objectives

- identify practical applications of a new broadband moth-eye antireflection (AR) coating technique in future NASA space missions
- simulate and optimize broadband moth-eye AR microstructures for far infrared and millimeter wavebands
- develop top-down and bottom-up processes for fabricating moth-eye AR coatings at this long wavelength region
- conduct cryogenic tests of AR coatings on silicon substrates to measure their key parameters to demonstrate the proof of concept
- advance this AR coating technology readiness level from TRL 1 to TRL 3




(Foreground) Simulated reflection spectra of a flat Si and a Si moth-eye AR coating. (Background) SEM image of a microfabricated Si moth-eye AR coating.

### Approach

- a rigorous coupled-wave analysis (RCWA) model will be used in simulating and optimizing moth-eye AR coatings
- top-down photolithography and deep reactive ion etching (DRIE) are going to be used in micropatterning moth-eye gratings with tapered geometries and high aspect ratios on the surfaces of planar silicon substrates
- bottom-up colloidal lithography and DRIE will be used in templating moth-eye AR gratings on the surfaces of non-planar substrates

### Potential Impact

- provide new generation AR coatings with extremely broad bandwidth and superior durability for space and airborne cosmic microwave background (CMB) missions
- produce new highly efficient and robust broadband AR coatings for silicon optics for cutting-edge CMB polarization measurements
- promote optics for popular Terahertz instruments for commercial, defense and national security applications
- develop high-efficiency crystalline silicon solar cells and advanced weapon systems (e.g., optical sighting system)